VERIFICATION OF TRANSLATION

I, SAITO Kiriko, a citizen of Japan, currently residing at 164-4-A-705, Wakashiba, Kashiwa-shi, Chiba, Japan, 277-0871, hereby declare:

That I am fully familiar with the English language and with the Japanese language in which the accompanying priority document (Japanese Patent Application No. 2003-352932) was prepared;

That the annexed English text is believed by me to be a true and accurate translation of the text of said priority document; and

That all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed at Tokyo, Japan
Date: September 6, 2010

Signature: K. Saito
SAITO Kiriko

[TITLE OF DOCUMENT] CLAIMS

[Claim 1]

A reproducing apparatus, characterized by comprising:

data acquiring means for acquiring content data, synchronization executing programs, and synchronization timing information items;

clock generating means for generating a clock signal;

decoding means for converting, in accordance with the clock signal, the content data into reproduction data for reproduction output;

synchronization control means for transmitting synchronization control signals to synchronization processing means, in accordance with the clock signal, at timings specified by timing specifying information items included in the synchronization timing information items, respectively; and

the synchronization processing means for generating output data by executing each of the synchronization executing programs and outputting the output data in accordance with each of the synchronization control signals received from the synchronization control means.

[Claim 2]

A reproducing apparatus, characterized by comprising:

data acquiring means for acquiring content data, synchronization executing programs, and synchronization timing information items;

clock generating means for generating a clock signal;

decoding means for converting, in accordance with the clock signal, the content data into reproduction data for reproduction output;

synchronization control means for transmitting synchronization control signals to synchronization processing means, in accordance with the clock signal, at timings specified by timing specifying information items included in the synchronization timing information items, respectively; and

the synchronization processing means for generating output data by executing each of the synchronization executing programs in accordance with each of the synchronization control signals received from the synchronization control means and outputting the output data.

[Claim 3]

The reproducing apparatus as set forth in claim 1 or 2,

characterized in that:

the synchronization processing means includes program executing means for generating output data by executing each of the synchronization executing programs in accordance with the synchronization control signal received from the synchronization control means.

[Claim 4]

The reproducing apparatus as set forth in claim 3, characterized in that:

the synchronization processing means includes output control means for outputting the output data generated by the program executing means in accordance with the synchronization control signal received from the synchronization control means.

[Claim 5]

The reproducing apparatus as set forth in claim 3 or 4, characterized in that:

the synchronization timing information items including the timing specifying information items includes action specifying information items, respectively and

when respectively transmitting the synchronization

control signals to the program executing means at the timings specified by the timing specified information items, the synchronization control means adds, to the synchronization control signals, action specifying information items corresponding to the timing specifying information items, respectively and

the program executing means executes a synchronization executing program specified by each of the action specifying information items included in the synchronization control signals received from the synchronization control means.

[Claim 6]

The reproducing apparatus as set forth in any one of claims 3 through 5, characterized in that:

the decoding means reproduces video data as the content data in order to output a video image, and

the program executing means executes, as the synchronization executing program, a program for generating image data to be overlaid with the video image.

[Claim 7]

A control program for causing the reproducing apparatus as set forth in any one of claims 1 through 6 to operate, and

for causing a computer to operate as the synchronization control means and the synchronization processing means.

[Claim 8]

A computer-readable recording medium for storing the control program as set forth in claim 7.

[Claim 9]

A content recording medium characterized in that at least any one of content data, a synchronization executing program, and synchronization timing information is stored such that the content data, the synchronization executing program, and the synchronization timing information are able to be supplied to the reproducing apparatus as set forth in any one of claims 1 through 6.

[Claim 10]

A content recording medium characterized in that content data and synchronization timing information are stored such that the content data and the synchronization timing information are able to be supplied to the reproducing apparatus as set forth in any one of claims 1 through 6,

the synchronization timing information being separated

from the content data.

[Claim 11]

A content recording medium characterized in that a synchronization executing program and synchronization timing information are stored such that the synchronization executing program and the synchronization timing information are able to be supplied to the reproducing apparatus as set forth in any one of claims 1 through 6,

the synchronization timing information being stored in a vicinity of the synchronization executing program.

[Claim 12]

A content recording medium characterized in that a synchronization executing program and synchronization timing information are stored such that the synchronization executing program and the synchronization timing information are able to be supplied to the reproducing apparatus as set forth in any one of claims 1 through 6,

the synchronization timing information and the synchronization executing program being stored in a same file.

[Claim 13]

A method for controlling a reproducing apparatus including decoding means and synchronization processing means,

said method, being characterized by comprising the steps of:

acquiring content data, a synchronization executing program, and synchronization timing information;

causing the decoding means to (i) convert, in accordance with a clock signal, the content data into reproduction data for reproduction output, and (ii) send a synchronization control signal to the synchronization processing means in accordance with the clock signal at a timing specified by timing specifying information included in the synchronization timing information; and

causing the synchronization processing means to generate output data by executing the synchronization executing program and output the output data in accordance with the synchronization control signal.

[Claim 14]

A method for controlling a reproducing apparatus including decoding means and synchronization processing

means,

said method, characterized by comprising the steps of:

acquiring content data items, synchronization executing programs, and synchronization timing information items;

causing the decoding means to (i) convert, in accordance with a clock signal, each of the content data items to reproduction data for reproduction output, and (ii) send synchronization control signals to the synchronization processing means in accordance with the clock signal at a timing specified by timing specifying information items included in the synchronization timing information items; and

causing the synchronization processing means to generate output data by executing each of the synchronization executing programs in accordance with the received synchronization control signals and output the output data.

[Claim 15]

A data structure, characterized by comprising:

a content data storing region for storing content data to be reproduced by a reproducing apparatus;

a synchronization executing program storing region for storing a synchronization executing program to be executed by the reproducing apparatus in synchronization with the

reproduction of the content data; and

a synchronization timing information storing region for storing, in accordance with a clock signal for causing the reproducing apparatus to reproduce the content data, synchronization timing information indicating a timing at which the synchronization executing program is executed.

[TITLE OF DOCUMENT] SPECIFICATION

[TITLE OF INVENTION] REPRODUCING APPARATUS, METHOD FOR CONTROLLING REPRODUCING APPARATUS, CONTENT RECORDING MEDIUM, DATA STRUCTURE, CONTROL PROGRAM, COMPUTER-READABLE RECORDING MEDIUM STORING CONTROL PROGRAM

[TECHNICAL FIELD]

The present invention relates to (i) a reproducing apparatus using computer software for controlling video reproduction (playback), (ii) a method for controlling the reproducing apparatus, (iii) a content recording medium, (iv) a data structure, (v) a control program, and (vi) a computer-readable recording medium storing the control program.

[BACKGROUND ART]

In recent years, for attainment of higher interactivity, AV (audio visual) devices have begun to adopt a platform in which a versatile program language can be executed. A typical example thereof is the MHP (Multimedia Home Platform) adopting Java® language (see Patent Literature, for example).

Described in Patent Literature 1 is a television display

apparatus that is so made as to have (i) various control functions, and (ii) an interface which is simple for a user. Specifically, the television display apparatus includes: (i) a memory for storing a plurality of control images, and for continuously storing major files; (ii) an event selector for correlating an event with selected one of the control images; (iii) an action selector for correlating an action with the selected control image; (iv) a display section for detecting the event and for displaying, in accordance with the detected event, the selected control image on a part of the display section of the television during a predetermined period such that the selected control image is overlaid with a currently viewed television service; (v) a command section for starting the action in response to a control command supplied by an input apparatus during the predetermined period. The command section causes display of a content of a major file corresponding to each major image displayed in response to the major command supplied by the input apparatus during the predetermined period. The content of the major file is so displayed as to be overlaid with the currently viewed television service.

[Patent Literature 1]

Japanese Unexamined Patent Publication *Tokukai* 2001-103383 (published on April 13, 2001)

[DISCLOSURE OF INVENTION]

[PROBLEMS TO BE SOLVED BY INVENTION]

Fig. 12 is a function block diagram schematically illustrating a structure of a conventional AV device having the versatile program language executing platform. In cases where such a versatile program language executing platform is adopted in the AV device as shown in Fig. 12, the AV device is made up of a program executing section 101, a video reproducing section 102 for decoding video data, and a combining section 103. The combining section 103 overlays respective outputs of the program executing section 101 and the video reproducing section 102 with each other. Generally, in view of cost and realtimeness, the video reproducing section 102 is hardware installed in the AV device.

However, it is difficult for such a conventional AV device to start displaying, from a specific video frame in time-sequential video reproduction, a graphics and an animation each generated by using the program, and to end the displaying at a specific video frame therein. This is because a program using an advanced computer language

(high-level language) operates slowly in general. Especially, a program using Java language is executed on a virtual machine. Moreover, a garbage collection process is carried out so as to free a used memory. This makes it difficult to secure real-time processing. Further, for synchronization of the graphics with the video at each frame, polling needs to be carried out at time shorter than the frame rate. Accordingly, the overhead due to the program becomes large. Further, software is required to check a clock value, for the sake of starting the display of the graphics from a specific timing and ending the display at a specific timing in the video reproduction. Accordingly, the overhead becomes large in the processing. This makes it difficult that each timing at which the display of the graphics is started and ended corresponds to the specific timing at each frame in the video reproduction. This is inefficient in terms of the processing.

The present invention is made in light of the problems, and its object is to provide (i) a reproducing apparatus which can effectively execute a program in synchronism with reproduction of AV data or the like; (ii) a method for controlling the reproduction apparatus; (iii) a content recording medium; (iv) a data structure; (v) a control program; and (vi) a computer-readable recording medium storing the

control program.

[MEANS TO SOLVE THE PROBLEMS]

To achieve the object, a reproducing apparatus according to the present invention is characterized by including: (a) data acquiring means for acquiring content data, synchronization executing programs, and synchronization timing information items; (b) clock generating means for generating a clock signal; (c) decoding means for converting, in accordance with the clock signal, the content data into reproduction data for reproduction output; (d) synchronization control means for transmitting synchronization control signals to synchronization processing means, in accordance with the clock signal, at timings specified by timing specifying information items included in the synchronization timing information items, respectively; and (e) the synchronization processing means for generating output data by executing each of the synchronization executing programs and outputting the output data in accordance with each of the synchronization control signals received from the synchronization control means.

Further, a reproducing apparatus according to the present invention is characterized by including: (a) data

acquiring means for acquiring content data, synchronization executing programs, and synchronization timing information items; (b) clock generating means for generating a clock signal; (c) decoding means for converting, in accordance with the clock signal, the content data into reproduction data for reproduction output; (d) synchronization control means for transmitting synchronization control signals to synchronization processing means, in accordance with the clock signal, at timings specified by timing specifying information items included in the synchronization timing information items, respectively; and (e) the synchronization processing means for generating output data by executing each of the synchronization executing programs in accordance with each of the synchronization control signals received from the synchronization control means and outputting the output data.

Further, the reproducing apparatus according to the present invention is characterized in that: the synchronization processing means includes program executing means for generating output data by executing each of the synchronization executing programs in accordance with the synchronization control signal received from the synchronization control means.

Further, the reproducing apparatus according to the present invention is characterized in that: the synchronization processing means includes output control means for outputting the output data generated by the program executing means in accordance with the synchronization control signal received from the synchronization control means.

Further, the reproducing apparatus according to the present invention is characterized in that: the synchronization timing information items including the timing specifying information items includes action specifying information items, respectively; and when respectively transmitting the synchronization control signals to the program executing means at the timings specified by the timing specified information items, the synchronization control means adds, to the synchronization control signals, action specifying information items corresponding to the timing specifying information items, respectively; and the program executing means executes a synchronization executing program specified by each of the action specifying information items included in the synchronization control signals received from the synchronization control means.

Further, the reproducing apparatus according to the

present invention is characterized in that: the decoding means reproduces video data as the content data in order to output a video image; and the program executing means executes, as the synchronization executing program, a program for generating image data to be overlaid with the video image.

A control program according to the present invention is a control program for causing the foregoing reproducing apparatuses to operate, and for causing a computer to operate as the synchronization control means and the synchronization processing means.

A computer-readable recording medium for storing a control program according to the present invention is a computer-readable recording medium for storing the foregoing control program.

A content recording medium according to the present invention is characterized in that: at least any one of content data, a synchronization executing program, and synchronization timing information is stored such that the content data, the synchronization executing program, and the synchronization timing information are able to be supplied to the foregoing reproducing apparatuses.

Further, a content recording medium according to the

present invention is characterized in that: content data and synchronization timing information are stored such that the content data and the synchronization timing information are able to be supplied to the foregoing reproducing apparatuses, the synchronization timing information being separated from the content data.

A content recording medium according to the present invention is characterized in that: a synchronization executing program and synchronization timing information are stored such that the synchronization executing program and the synchronization timing information are able to be supplied to the foregoing reproducing apparatuses, the synchronization timing information being stored in a vicinity of the synchronization executing program.

A content recording medium according to the present invention is characterized in that: a synchronization executing program and synchronization timing information are stored such that the synchronization executing program and the synchronization timing information are able to be supplied to the foregoing reproducing apparatuses, the synchronization timing information and the synchronization executing program being stored in a same file.

Further, a method, according to the present invention,

for controlling a reproducing apparatus including decoding means and synchronization processing means, includes the steps of: causing the data acquiring means to acquire content data, a synchronization executing program, and synchronization timing information; causing the decoding means to (i) convert, in accordance with the clock signal, the content data into reproduction data for reproduction output, and (ii) send a synchronization control signal to the synchronization processing means in accordance with the clock signal at a timing specified by timing specifying information included in the synchronization timing information; and causing the synchronization processing means to generate output data by executing the synchronization executing program and output the output data in accordance with the synchronization control signal.

Further, a method, according to the present invention, for controlling a reproducing apparatus including decoding means and synchronization processing means is characterized by comprising the steps of: acquiring content data items, synchronization executing programs, and synchronization timing information items; causing the decoding means to (i) convert, in accordance with a clock signal, each of the content data items to reproduction data for reproduction

output, and (ii) send synchronization control signals to the synchronization processing means in accordance with the clock signal at a timing specified by timing specifying information items included in the synchronization timing information items; and causing the synchronization processing means to generate output data by executing each of the synchronization executing programs in accordance with the received synchronization control signals and output the output data.

A data structure according to the present invention is characterized by including: a content data storing region for storing content data to be reproduced by a reproducing apparatus; a synchronization executing program storing region for storing a synchronization executing program to be executed by the reproducing apparatus in synchronization with the reproduction of the content data; and a synchronization timing information storing region for storing, in accordance with a clock signal for causing the reproducing apparatus to reproduce the content data, synchronization timing information specifying a timing at which the synchronization executing program is executed.

[EFFECTS OF INVENTION]

As described above, a reproducing apparatus according to the present invention includes: data acquiring means; clock generating means; decoding means; synchronization control means; and synchronization processing means for outputting output data in accordance with each of synchronization signals. Meanwhile, a method, according to the present invention, for controlling a reproducing apparatus includes the steps of: acquiring data, decoding, and outputting data in accordance with synchronization control signals.

This makes it possible to supply, to the synchronization processing means, each synchronization control signal (trigger) that specifies the timing at which the result (output data) obtained by executing the synchronization executing program is outputted. The supply of the synchronization control signal is carried out in synchronization with the reproduction process that the decoding means carries out with respect to the content data.

Further, a reproducing apparatus according to the present invention includes: data acquiring means; clock generating means; decoding means; synchronization control means; and synchronization processing means for executing each of the synchronization executing programs in accordance

with each of synchronization control signals. Meanwhile, a method, according to the present invention, for controlling a reproducing apparatus includes the steps of: acquiring data, decoding, and executing each of synchronization executing programs in accordance with synchronization control signals.

This makes it possible to supply, to the synchronization processing means, the synchronization control signal (trigger) that specifies the timing at which the output data is generated by executing the synchronization executing program. The supply of the synchronization control signal is carried out in synchronization with the reproduction process that the decoding means carries out with respect to the content data.

Accordingly, the synchronization processing means does not need to check the reproduction clock of the decoding means, so that no load is imposed for the synchronization on the synchronization processing means. This produces an effect that it is possible to effectively execute a program in synchronization with reproduction of AV data or the like.

For example, in the case of starting/ending display of a graphics at a specific timing in the video reproduction, the clock does not need to be checked by using the software constituting the synchronization processing means, so that no

overhead occurs due to the process. This makes it possible to coincide the timings at a frame rate. In other words, high-precision control can be carried out. The arrangement is excellent also in terms of process efficiency.

Note that the data acquiring means may be either (i) means for reading out the content data, the synchronization executing program, and the synchronization timing information from the content recording medium, or (ii) communication means for acquiring the content data, the synchronization executing program, and the synchronization timing information via a network. In other words, the supply of the content data, the synchronization executing program, and the synchronization timing information to the reproducing apparatus can be carried out in various manners. For example, the reproducing apparatus may read out the content data, the synchronization executing program, and the synchronization timing information from the content recording medium. Alternatively, any one of the content data, the synchronization executing program, and the synchronization timing information may be acquired via the network, and may be combined with the other data read out from the content recording medium, with the result that the reproduction is carried out. Further, a part or all of the

synchronization executing programs stored in the content recording medium may be replaced with synchronization executing programs acquired via the network for the sake of the reproduction. Further, a part or all of the content data stored in the content recording medium may be replaced with content data acquired via the network for the sake of the reproduction. Further, a part or all of the synchronization timing information stored in the content recording medium may be replaced with synchronization timing information acquired via the network for the sake of the reproduction.

Further, examples of the program include: (i) a program for generating data of an image (still image; animation) to be overlaid with a video image, (ii) a program for outputting only a sound such as a sound effect or narration.

Further, a reproducing apparatus according to the present invention is arranged such that the synchronization processing means includes the program executing means. This makes it possible to execute the synchronization executing program in accordance with the synchronization control signal generated in accordance with the clock signal used for the reproduction of the content data. Accordingly, the output data can be generated by executing the synchronization executing program in synchronization with

the reproduction of the content data.

Further, the reproducing apparatus according to the present invention is arranged such that the synchronization processing means includes output control means. This makes it possible to output, in accordance with the synchronization control signal generated in accordance with the clock signal used for the reproduction of the content data, the output data generated by using the synchronization executing program. Accordingly, the output caused by the synchronization executing program can be controlled in synchronization with the reproduction of the content data.

Further, the reproducing apparatus according to the present invention is arranged such that: the synchronization control means adds, to the synchronization control signals, action specifying information items corresponding to the timing specifying information items, respectively to send to the program executing means, and the program executing means executes a synchronization executing program specified by each of the action specifying information items included in the synchronization control signals.

This allows the synchronization control means to control the synchronization executing program at such a timing that the program executing means carries out the process. This

makes it possible that the program executing means switchably executes a plurality of synchronization executing programs (instructions).

Further, the reproducing apparatus according to the present invention is arranged such that: the decoding means reproduces video data as the content data in order to output a video image, and the program executing means executes, as the synchronization executing program, a program for generating image data to be overlaid with the video image.

This makes it possible to overlay (i) the video image reproduced by the decoding means, with (ii) the image data generated by using the program executing means. The overlaying is carried out in synchronization with the reproduction of the video image. Note that the image data generated by using the program executing means may be either a still image or an animation.

Note that the reproducing apparatus may be realized by a computer. In this case, the present invention encompasses (i) a control program for causing a computer to operate as the aforementioned various means, particularly the synchronization control means and the synchronization processing means, so that the reproducing apparatus is realized by the computer; and (ii) a computer-readable

recording medium storing the control program.

Further, a content recording medium according to the present invention is so arranged as to store at least any one of content data, a synchronization executing program, and synchronization timing information such that the content data, the synchronization executing program, and the synchronization timing information are able to be supplied to the reproducing apparatus.

Further, a content recording medium according to the present invention is arranged such that the synchronization timing information is separated from the content data.

With the arrangement, the content data (video data) and the synchronization timing information are separately managed. This makes it easier to share one content data with a plurality of synchronization executing programs. Further, the synchronization timing information and each of the synchronization executing programs are managed as different files, so that the synchronization executing program does not need to be rewritten even in cases where the video data is edited after creating the program.

Further, a content recording medium according to the present invention is arranged such that the synchronization timing information is stored in a vicinity of the

synchronization executing program.

With the above arrangement, the pickup travels only a short distance so as to read out these data when executing the synchronization executing program. This makes it possible to (i) shorten latency time required in starting the reproduction, and (ii) prevent discontinuity of the video reproduction, and (iii) restrain increase of power consumption and occurrence of noise.

Further, a content recording medium according to the present invention is arranged such that the synchronization timing information and the synchronization executing program are stored in a same file.

This makes it possible to reduce the number of files to be read out, with the result that overhead occurring due to the readout is reduced.

Further, a data structure according to the present invention includes: a content data storing region; a synchronization executing program storing region; and a synchronization timing information storing region. This allows realization of the content recording medium storing these data, with the result that these data can be supplied to the reproducing apparatus with ease.

[BEST MODE FOR CARRYING OUT THE INVENTION]

One embodiment of the present invention will be explained below with reference to Fig. 1 through Fig. 11. Note that the present embodiment assumes a video disk player; however, the present invention is not limited to this, and is applicable to a PC (personal computer) having a hardware decoder and the like.

<System Structure>

Fig. 1 is a functional block diagram schematically illustrating a structure of a video disk player 1 according to the present embodiment.

The video disk player 1 (reproducing apparatus) is an apparatus for reproducing AV data stored in an optical disk 2. As shown in Fig. 1, the video disk player 1 includes a program executing section 10, a video reproducing section 20, a combining section 30, an output control section 40, and disk reading section 50.

The disk reading section 50 (data acquiring means; reading means) reads out video data (content data), programs (synchronization executing programs), and synchronization timing information from the optical disk 2 (content recording medium). Then, the disk reading section 50 sends each of the programs to the program executing section 10, and sends the

video data and the below-described synchronization timing information to the video reproducing section 20.

The program executing section 10 executes the program. Specifically, the program executing section 10 executes the program so as to control the video reproducing section 20, the disk reading section 50, and the output control section 40. Moreover, the program executing section 10 sends, to the output control section 40, bitmap data generated by executing the program.

The video reproducing section 20 decodes the video data supplied from the disk reading section 50, and sends the decompressed video data to the combining section 30. Further, the video reproducing section 20 controls the program executing section 10 and the output control section 40 in accordance with the synchronization timing information supplied from the disk reading section 50.

The output control section 40 retains the bitmap data sent from the program executing section 10, and sends the bitmap data to the combining section 30 in accordance with the control carried out by each of the video reproducing section 20 and the program executing section 10.

The combining section 30 combines (i) the bitmap data sent from the output control section 40, with (ii) the

decompressed video data sent from the video reproducing section 20. Then, the combine section 30 outputs an image (combined image) obtained by the combining.

The program executing section 10 and the output control section 40 constitute a synchronization processing section (synchronization processing means) 60. That is, the synchronization processing section 60 is arranged such that: the program executing section 10 executes the program so as to generate the bitmap data (output data) in accordance with a synchronization control signal received from the video reproducing section 20, and the output control section 40 outputs the bitmap data in accordance with the synchronization control signal received from the video reproducing section 20.

<Program executing section>

Fig. 2 is a functional block diagram fully illustrating a structure of the program executing section 10.

As described above, the program executing section 10 executes a program in accordance with the synchronization control signal received from a synchronization control section 22 of the video reproducing section 20. The program executing section 10 executes a program specified by a field *action_id* contained in the synchronization control signal

received from the synchronization control section 22. Particularly in the present embodiment, the program executing section 10 executes a program for generating image data to be overlaid with a video image.

As shown in Fig. 2, the program executing section 10 is made up of a memory 11, a CPU 12, and a video reproduction control section 13, and an interrupt control section 14.

The memory 11 temporarily stores the program sent from the disk reading section 15. The CPU 12 reads out the program thus stored in the memory 11, and executes the program. In accordance with how the problem runs, the CPU 12 sends an instruction to the video reproduction control section 13, or sends the bitmap data to the output control section 40. The video reproduction control section 13 sends a control signal to the video reproducing section 20 in accordance with the program thus executed. Specific examples of the control signal include: (i) a control signal for controlling the reproduction such as reproduction start and reproduction suspending, and (ii) a control signal for acquiring a state such as a current reproduction time point. The interrupt control section 14 receives an interrupt from outside of the program executing section 10, and sends the interrupt to the CPU 12. The CPU 12 launches an interrupt

handler upon the reception of the interrupt from the interrupt control section 14. Note that various types of information supplied from the member having sent the interrupt are stored in a register (not shown) of the interrupt control section 14.

<Output control section>

Fig. 3 is a function block diagram fully illustrating a structure of the output control section 40.

As shown in Fig. 3, the output control section 40 is made up of an input side buffer switching section 41, a display buffer memories 42A(#1) and 42B(#2), and an output side buffer switching section 43.

The input side buffer switching section 41 receives the bitmap data from the program executing section 10, and sends the bitmap data to either one of the display buffer memories 42A and 42B in accordance with the control of the program executing section 10. The output side buffer switching section 43 sends, to the combining section 30 in accordance with the control carried out by the video reproducing section 20, the data stored in either one of the display buffer memories 42A and 42B.

Each of the display buffer memories 42A and 42B is a buffer memory for storing the bitmap data, and is controlled

via the input side buffer switching section 41 and the output side buffer switching section 43 as described above.

<Video reproducing section>

Fig. 4 is a function block diagram fully illustrating a structure of the video reproducing section 20.

As shown in Fig. 4, the video reproducing section 20 is made up of a memory 21, a synchronization control section 22, a clock 23, a decoder 24, and an interface section 25.

The decoder 24 (decoding means) converts, in accordance with a clock signal, the video data into the decompressed video data for reproduction output. Specifically, the decoder 24 decodes, into the decompressed video data (video image), the video data which is supplied by the disk reading section 50. Then, the decoder 24 outputs the decompressed video data thus obtained.

The clock (clock generating means) 23 produces timings at which the decoding and the output of the decompressed video data are carried out. That is, the clock 23 generates the clock signal. Note that: the present embodiment assumes that the video data is stored in the optical disk 2 in compliance with the ISO/IEC 13818-1 Program Stream format. In this case, the clock 23 has a value corresponding to an STC (System Time Clock) of the ISO/IEC 13818-1 Program Stream

format.

The memory 21 stores the synchronization timing information sent from the disk reading section 50.

The synchronization control section (synchronization controlling means) 22 always compares (i) a value indicated by the synchronization timing information stored in the memory 21, with (ii) the value of the clock 23. In cases where the value indicated by the synchronization timing information coincides with the value of the clock 23, the synchronization control section 22 carries out specified control with respect to a process block (program executing section 10 or the output control section 40) specified by the synchronization timing information. Specifically, the synchronization control section 22 transmits the synchronization control signal to the program executing section 10 (program executing means) in accordance with the clock signal, at a timing specified by a field *timing* (timing specifying information) contained in the synchronization timing information. When transmitting the synchronization control signal to the program executing section 10 at the timing specified by the field *timing*, the synchronization control section 22 adds, to the synchronization control signal, the field *action_id* corresponding to the field *timing*.

In cases where the process block specified by the synchronization timing information is the program executing section 10, the synchronization control section 22 interrupts the interrupt control section 14 such that the information is set in the register of the interrupt control section 14.

On this account, no load is imposed in executing the program, with the result that the processing can be carried out at an arbitrary timing in the video reproduction time period. A reason of this is as follows. That is, the interrupt mechanism is made up of the hardware, so that no polling processing for making a reference to the clock of the video reproducing section 20 is required by the program unlike the conventional technique. Accordingly, overhead due to the polling processing never occurs.

On the other hand, in cases where the process block specified by the synchronization timing information is the output control section 40, the synchronization control section 22 sends an instruction to the output side buffer switching section 43 such that switching is carried out between the display buffer memories 42A and 42B. This makes it possible to switch, at a frame precision, image outputs generated by using the program. A reason of this is as follows. That is, the switching is carried out between the hardware, i.e., between

the display buffer memories 42A and 42B, so that the overhead due to the execution of the program is less likely to occur as compared with the conventional technique in which the switching between display and non-display is controlled by using a program. Examples of such an overhead include the function calling, the garbage collection, and the like.

Further, the interface section 25 of the video reproducing section 20 receives the control signal from the video reproduction control section 13 of the program executing section 10. In accordance with the control signal, the interface section 25 controls the decoder 24 and sends, to the video reproduction control section 13, information indicative of the current state of the video reproducing section 20.

<Synchronization timing information>

Explained here is a data structure of the data stored in the optical disk 2, with reference to Figs. 5 and Fig. 6.

The optical disk 2 stores the video data, the program, and the synchronization timing information such that the video data, the program, and the synchronization timing information can be supplied to the video disk player 1.

Each of Fig. 5(a) and Fig. 5(b) is an explanatory diagram illustrating a data structure of the synchronization timing

information. As shown in Fig. 5(a), the synchronization timing information is made up of (i) *number_of_sync_info* indicating the number of entries, and (ii) zero or more entries *sync_info()*. See Fig. 5(b). Each of the entries *sync_info()* is made up of three fields: *timing*, *target*, and *action_id*. That is, the synchronization timing information at least include (i) the field *timing* (timing specifying information) and (ii) the field *action_id* (action specifying information).

The field *timing* indicates timing at which an instruction is supplied to either the program executing section 10 or the output control section 40. The field *timing* is used, by the synchronization control section 22, for the comparison with the value of the clock 23.

The field *target* indicates a target to which the instruction is given. The field *target* specifies either one of the program executing section 10 and the output control section 40.

The field *action_id* represents the instruction. Note that details about the field *action_id* will be described later.

As such, the synchronization timing information includes the field *target* indicating the target to which the instruction is given. This makes it possible to deal with a case where the instruction is supplied to a plurality of process

blocks. Further, the field *action_id* representing the instruction is included in the synchronization timing information, with the result that a plurality of instructions can be given to one process block.

<Data allocation and file structure>

Fig. 6 is an explanatory diagram illustrating data allocation in the optical disk 2.

As shown in Fig. 6, the optical disk 2 is made up of a management information region 61 and a video data region (content data storing region) 62. The management information region 61 is made up of (i) a program storing region (synchronization program storing region) 61A storing the programs, and (ii) a synchronization timing information storing region 61B storing the synchronization timing information. On the other hand, the video data region 62 stores the video data. Note that the synchronization timing information, the programs, and the video data are managed as files, individually.

Particularly in the present embodiment, the synchronization timing information is stored separately from the video data. Moreover, the synchronization timing information is stored in the vicinity of the programs. Further, the synchronization timing information and each of the

programs are stored in the same file.

As such, the video data and the synchronization timing information are separately managed. This makes it easier to share one video data with a plurality of programs. Further, the synchronization timing information and each of the programs are managed as different files, so that the program does not need to be rewritten even in cases where the video data is edited after creating the program.

Note that the supply of the video data, the program, and the synchronization timing information to the video disk player 1 can be carried out in various manners. For example, the video disk player 1 may read out the video data, the program, and the synchronization timing information from the optical disk 2. Alternatively, any one of the video data, the program, and the synchronization timing information may be acquired via a network by using a communication section (communication means; not shown), and may be combined with the other data read out from the optical disk 2, with the result that the reproduction is carried out. Further, a part or all of the programs stored in the optical disk 2 may be replaced with programs acquired via the network for the sake of the reproduction. Further, a part or all of the video data stored in the optical disk 2 may be replaced with video data

acquired via the network for the sake of the reproduction. Further, a part or all of the synchronization timing information stored in the optical disk 2 may be replaced with synchronization timing information acquired via the network for the sake of the reproduction.

For example, the video disk player 1 shown in Fig. 1 may be arranged such that the program and the synchronization timing information are acquired via the network. Such a structure allows a manufacturer of the optical disk 2 to render, via the network, an additional value to the video data provided for the user by way of the optical disk 2. Each of the program and the synchronization timing information has a data amount much smaller than that of the video data. Therefore, such a way of rendering the additional value after providing the optical disk 2 for the user is beneficial in terms of communication cost such as time and a charge.

<Reproducing process>

The following explains a reproducing process carried out by the video disk player 1, with reference to Fig. 7.

Fig. 7 is a flowchart illustrating an entire flow of the reproducing process carried out by the video disk player 1.

After being powered ON, the video disk player 1 reads out file system information (not shown) and the like from the

optical disk 2, and initializes respective processing sections. In accordance with the file system information thus read out, the disk reading section 50 acquires information indicative of a position, which stores an automatic launch program, of the optical disk 2 (S11). Note that the automatic launch program can be identified in accordance with a filename.

The automatic launch program is a program firstly launched from the optical disk 2 in response to either (i) insertion of the optical disk 2 to the video disk player 1, or (ii) the powering-ON of the video disk player 1. The automatic launch program may be any program which the manufacturer of the optical disk 2 would like to launch. However, normally used as the automatic launch program is a menu display program for use in selection of a plurality of contents stored in the optical disk 2. Information indicative of the position storing the automatic launch program can be acquired by the disk reading section 50 in accordance with the specific filename beforehand given to the file storing the automatic launch program.

Next, the disk reading section 50 reads out a program in accordance with information indicative of the position storing the program, and sends the readout program to the program executing section 10 (S12). The program executing section 10

receives and executes the program (S13). On this occasion, the disk reading section 50 acquires information indicative of a position, which stores a program to be executed next, in the optical disk 2 (S14).

Explained next is a step S13 in which the program executing section 10 executes the program, with reference to Fig. 8.

Firstly, the program executing section 10 registers the interrupt handler for dealing with the interrupt sent from the video reproducing section 20 (S21). Note that explanation about the interrupt handler will be made later. Next, the program executing section 10 specifies a video data file to be reproduced, and instructs the video reproducing section 20 to start the reproduction thereof (S22). Finally, a process requiring no synchronization with the video reproduction is executed (S23).

<Specific example>

Explained next is a specific example how the video disk player 1 executes the program, with reference to Fig. 9 through Fig. 11. Exemplified here is a program which causes a still image to be displayed during a period of time from time point T2 to time point T4 in the video data reproduction, and

which causes an animation to be displayed during a period of time from a time point T4 to a time point T5.

Now, a setting of the interrupt handler of the present specific example will be explained with reference to the flowchart shown in Fig. 9.

Firstly, the CPU 12 launches the interrupt handler. Then, in reference to the register of the interrupt control section 14, the CPU 12 acquires a value of the field *action_id,* which value is set by the video reproducing section 20 (S31). Thereafter, the CPU 12 carries out judgment on the field *action_id* (S32).

In cases where the field *action_id* is indicative of "A1" in the step S32, the CPU 12 causes the still image to be generated and written in the display memory buffer 42A (S33). On the other hand, in cases where the field *action_id* is indicative of "A2", the CPU 12 causes the animation to be generated, and causes bitmap of the animation to be written in the memory buffer 42B (S34). In the meanwhile, in cases where the field *action_id* is indicative of "A3", the CPU 12 causes the generation of the animation to be ended (S35).

Fig. 10 illustrates the synchronization timing information used in the present specific example. Note that "A1", "A2", and "A3" in the column indicating the field *action_id* correspond to the processes shown in Fig. 9,

respectively. Further, Fig. 11 is a timing chart of the present specific example. The timing chart has a horizontal axis representing a time period during which the video data is reproduced.

The process for displaying the still image starts at time point T1. At a time point t1, the writing of the still image in the display buffer memory 42A is finished, with the result that preparation for the display is completed. Next, at time point T2, the image to be supplied to the combining section 30 is switched to the image written in the display buffer memory 42A(#1), with the result that the still image is displayed.

Important here is that time T2 – T1 is so set as to be longer than time d1 (= t1 – T1) required for the writing of the still image in the display buffer memory 42A. This allows the still image to be displayed at the specified time point T2.

In the meanwhile, the process for starting the display of the animation starts at a time point T3. At a time point t2, the writing of first bitmap data of the animation in the display buffer memory 42B is completed. Next, at a time point T4, the image to be supplied to the combining section 30 is switched to the image written in the display buffer memory 42B(#2), with the result that the animation is displayed.

Important here is that time T4 – T3 is so set as to be longer than time d2 (= t2 – T3) required for the writing of the first bitmap data of the animation in the display buffer memory 42B. This makes it possible to switch the image display from the still image to the animation at a time point T4.

Explained next are timings at which the various types of data of the present embodiment are read out from the optical disk 2, respectively. The video data has a large data amount. Therefore, in view of a memory amount and readout time, it is not realistic to read out the video data all at once before the decoding. For this reason, the readout of the video data is carried out concurrently with the decoding of the video data.

On the other hand, each of the program and the synchronization timing information has a small data amount. Therefore, even when the program and the synchronization timing information are respectively read out to the memories 11 and 21 at the same time, no problem occurs in terms of the memory amount and the readout time. Therefore, the program and the synchronization timing information are read out at the same time before the start of the readout of the video data. This makes it possible to avoid (i) discontinuity of the video reproduction due to movement made by a pickup

(not shown) of the disk reading section 50 that is reading out the video data, (ii) increase of power consumption, and (iii) occurrence of noise. In the present embodiment, the program and the synchronization timing information are positioned adjacent to each other in the optical disk 2, so that the pickup travels in a short distance so as to read out the program and the synchronization timing information. This makes it possible to (i) shorten latency time (waiting time) required for the start of the reproduction, and (ii) prevent the interruption of the video reproduction, and (iii) restrain the power consumption, and (iv) restrain the noise.

Explained next is a structure of the program of the present specific example. In the present specific example, the program deals with (i) the video reproducing process that is a main process, and (ii) the still image displaying process and the animation displaying process which are sub processes. The video reproducing process, the still image displaying process, and the animation displaying process may be handled by one program. Alternatively, the video reproducing process, the still image displaying process, and the animation displaying process may be handled by one main program and two sub programs.

In cases where the processes are handled by the plural

programs, the programs are possibly handled as different files. In this case, it is preferable that the programs be handled as one file for the purpose of reducing load to be imposed on the disk reading section 50. A file format termed "JAR (Java ARchive) file defined in Java language is a specific example for use in reducing the load.

As described above, the video disk player 1 of the present embodiment includes the program executing section 10, the video reproducing section 20, and the combining section 30 for combining (i) the output (bitmap data) of the program executing section 10 with (ii) the output (decompressed video data) of the video reproducing section 20. Moreover, the video disk player 1 controls the output of the program executing section 10 in accordance with the synchronization timing information and the clock of the video reproducing section 20. On this account, no load is imposed during the process carried out by the program executing section 10, so that the outputting of the video data, i.e., the output generated by the video reproducing section 20, can be started and ended at a specified timing with a frame precision. This makes it possible that: in cases where the computer program execution and the video reproduction are simultaneously carried out, the display of the graphics, the

animation, and the like each generated by the program is started from a specific video frame in the video reproduction time period, and is ended at a specific video frame therein.

Further, in the video disk player 1, the synchronization timing information is separated from the information (video data) for use in generating the output of the video reproducing section 20. This makes it possible that different items of synchronization timing information are given to the information for use in generating the output of the video reproducing section 20.

Further, in the video disk player 1, the synchronization timing information includes (i) the information indicative of a time point in the time period during which the video reproduction is carried out by the video reproducing section 20; and (ii) at least either one of (a) the information indicative of the control target, and (b) the information indicative of the control to be carried out. This makes it possible to handle (i) a case where an instruction is given to a plurality of process blocks, and (ii) a case where a plurality of instructions are switchably given to one process block.

Note that the present embodiments do not limit the scope of the present invention, but rather may be applied in many variations within the scope of the invention. For

example, the following configurations are possible.

In each of the present embodiments, the video data, the synchronization timing information, and the program are stored in the optical disk; however, the video data, the synchronization timing information, and the program may be stored in either (i) another recording medium such as a hard disk, or (ii) another recording medium connected to the video disk player via a network. The video data, the synchronization timing information, and the program may be stored different recording medium, respectively.

In each of the present embodiments, the program and the synchronization timing information are managed by using different files, respectively; however, the program and the synchronization timing information may be managed by using the same file. In this case, the synchronization timing information is sent from the program executing section to the video reproducing section, unlike the present embodiments. Accordingly, the number of files to be read out is reduced, with the result that the overhead is reduced. This is an additional effect.

The present embodiments assume that the outputs respectively sent from the program executing section and the video reproducing section, i.e., the outputs to be combined

together are images; however, a structure similar to the above structure is applicable to the case of combining sounds (audio).

The present embodiments assume that the program executing section executes a versatile program; however, the present invention is not limited to this. For example, even when the program executing section is a process section having a single function such as a function of carrying out a still image slide show reproduction, the effects of the present invention can be exhibited.

In the present embodiments, the program executing section and the output control section are controlled in accordance with the synchronization timing information; however, both the program executing section and the output control section are not necessarily controlled in accordance with the synchronization timing information. For example, the control can be carried out at a frame rate, even when only the output control section is controlled in accordance with the synchronization timing information and when the program executing section uses an individual clock so as to set a timing at which the bitmap image is generated.

In the present embodiments, only the switching of the display buffer memories of the output control section is

carried out in accordance with the field *action_id*; however, the present invention is not limited to this.

Further, the present embodiments assume that the program executing section and the output control section are targets to be controlled; however, the combining section may be the target to be controlled. In this case, a specific example of the control over the combining section is a control of changing an order of display planes; or the like.

Further, the present embodiment uses the two display buffer memories; however, the present invention is not limited to this. The effects of the present invention can be exhibited even when using one or not less than three display buffers.

In the present embodiments, one block, i.e., the program executing section is used to output the image concurrently with the video reproducing section; however, the effects of the present invention can be exhibited even when a plurality of image outputting blocks are used.

In the present embodiments, the video reproducing section carries out the control in accordance with the synchronization timing information; however, the present invention is not limited to this. The effects of the present invention can be exhibited as long as a component using the same clock as that of the video reproducing section is used.

The reproducing apparatus of the present invention may include the first output generating section and the second output generating section, and the means for controlling outputting of the second generating section in accordance with the synchronization timing information and the clock of the first output generating section.

Further, the reproducing apparatus of the present invention may be arranged such that the synchronization timing information is separated from the information for use in generating the output of the first output generating section.

The reproducing apparatus of the present invention may be arranged such that the synchronization timing information at least include (i) information indicative of a time point in a time period of the first output generating section, and (ii) either one of (a) information indicative of a control target or (b) information indicative of what control is to be carried out.

Further, the reproducing apparatus of the present invention may be arranged such that: the first output generating section is a video reproducing section, and the second output generating section is a program executing section.

Further, the reproduction method of the reproducing

apparatus, which includes the first output generating section and the second output generating section, of the present invention may include: (i) a step of comparing the synchronization timing information with the clock of the first output generating section; and (ii) a step of outputting the control signal in accordance with the comparison result.

Further, the recording medium of the present invention may be a recording medium which stores (i) the information for use in generating the output of the first output generating section; (ii) the information for use in generating the output of the second output generating section; and (iii) the synchronization timing information for controlling the outputting of the second output generating section in accordance with the clock of the first output generating section.

Further, the recording medium of the present invention may be arranged such that the timing information is stored in the vicinity of the information for use in generating the output of the second output generating section.

Further, the recording medium of the present invention may be arranged such that the timing information and the program are stored in the same file.

Finally, the blocks of each of the video disk players 1,

particularly the program executing section 10 and the synchronization control section 22, may be constituted by hardware logic, or by software with the use of a CPU as follows.

That is, each of the video disk player 1 has: (i) the CPU (central processing unit) for executing an instruction of a control program realizing various functions; (ii) a ROM storing the program; (iii) a RAM for expanding the program; (iv) a storage device (storage medium) such as a memory storing the program and various data; and (v) the like. The object of the present invention also can be achieved by (i) providing, for each of the video disk player 1, a storage medium storing, in a computer readable manner, a program code (executable program; intermediate code; source program) of the control program for the video disk player 1, and (ii) causing a computer (CPU or MPU) to read and execute the program code stored in the storage medium, the program code being the software realizing the aforementioned functions.

Examples of the storage medium are: (i) tapes such as a magnetic tape and a cassette tape; (ii) magnetic disks such as a floppy® disk and a hard disk; (iii) optical disks such as a CD-ROM (compact disk read only memory), a magnetic optical disk (MO), a mini disk (MD), a digital video disk (DVD), and a

CD-R (CD-Rewritable); (iv) cards such as an IC card (inclusive of a memory card) and an optical card; and (v) semiconductor memories such as a mask ROM, an EPROM (electrically programmable read only memory), an EEPROM (electrically erasable programmable read only memory), and a flash ROM.

Each of the video disk player 1 may be connectable to the communication network, and the program code may be supplied via the communication network. The communication network is not particularly limited. Specific examples thereof are: the Internet, Intranet, Extranet, LAN (local area network), ISDN (integrated services digital network), VAN (value added network), CATV (cable TV) communication network, virtual private network, telephone network, mobile communication network, satellite communication network, and the like. Further, the transmission medium constituting the communication network is not particularly limited. Specific examples thereof are: (i) a wired channel using an IEEE 1394, a USB (universal serial bus), a power-line communication, a cable TV line, a telephone line, a ADSL line, or the like; or (ii) a wireless communication using IrDA, infrared rays used for a remote controller, Bluetooth®, IEEE 802.11, HDR (High Data Rate), a mobile phone network, a satellite connection, a terrestrial digital network, or the like. Note that, the present

invention can be realized by (i) a carrier wave realized by electronic transmission of the program code, or (ii) a form of a series of data signals.

[INDUSTRIAL APPLICABILITY]

A reproducing apparatus of the present invention makes it possible to efficiently execute a program in synchronization with reproduction of AV data or the like. For this reason, the reproducing apparatus can be suitably used for a video player for overlaying, with currently reproduced video data, a graphic output generated by using a computer program; and the like.

[BRIEF DESCRIPTION OF DRAWINGS]

[Fig. 1]

Fig. 1 is a block diagram schematically illustrating a structure of a video disk player according to an embodiment of the present invention.

[Fig. 2]

Fig. 2 is a function block diagram fully illustrating a structure of a program executing section of the video disk player shown in Fig. 1.

[Fig. 3]

Fig. 3 is a function block diagram fully illustrating a structure of an output control section of the video disk player shown in Fig. 1.

[Fig. 4]

Fig. 4 is a function block diagram fully illustrating a structure of a video reproducing section of the video disk player shown in Fig. 1.

[Fig. 5]

Fig. 5(a) and Fig. 5(b) are explanatory diagrams each illustrating a data structure of synchronization timing information.

[Fig. 6]

Fig. 6 is an explanatory diagram illustrating data allocation in an optical disk reproduced by the video disk player shown in Fig. 1.

[Fig. 7]

Fig. 7 is a flowchart illustrating a reproducing process carried out by the video disk player shown in Fig. 1.

[Fig. 8]

Fig. 8 is a flowchart illustrating a program executing process carried out by a program executing section of the video disk player shown in Fig. 1.

[Fig. 9]

Fig. 9 is a flowchart illustrating a process which the program executing section of the video disk player shown in Fig. 1 causes an interrupt handler to carry out.

[Fig. 10]

Fig. 10 is an explanatory diagram illustrating an specific example of the synchronization timing information.

[Fig. 11]

Fig. 11 is a timing chart corresponding to the specific example of the synchronization timing information shown in Fig. 10.

[Fig. 12]

Fig. 12 is a function block diagram schematically illustrating a structure of a conventional AV device.

[DESCRIPTION OF REFERENCE SIGNS]

1 Video Disk Player (Reproducing Apparatus)

2 Optical Disk (Content Recording Medium)

10 Program Executing Section (Program Executing Means)

22 Synchronization Control Section (Synchronization Control Means)

24 Decoder (Decoding Means)

23 Clock (Clock Generating Means)

40 Output Control Section (Output Control Means)

50 Disk Reading Section (Data Acquiring Means)

60 Synchronization Processing Section (Synchronization Processing Means)

61A Program Storing Region (Synchronization Program Storing Region)

61B Synchronization Timing Information Storing Region

62 Video Data Region (Content Data Storing Region)

[TITLE OF THE DOCUMENT] ABSTRACT

[ABSTRACT]

[OBJECT]

A program is efficiently executed in synchronization with reproduction of AV data or the like.

[MEANS TO ACHIEVE THE OBJECT]

A video disk player 1 includes: (A) a video reproducing section 20 including (i) a disk reading section 50 for reading out video data, a program, synchronization timing information from an optical disk 2; (ii) a clock for generating a clock signal; and (iii) a decoder for converting, in accordance with the clock signal, the video data into decompressed video data for reproduction output; (B) a synchronization control section 22 for transmitting, in accordance with the clock signal, a synchronization control signal to a program executing section 10 at a timing specified by a field *timing* contained in the synchronization timing information; and (C) the program executing section 10 for executing a program in accordance with the synchronization control signal received from the synchronization control means.

[SELECTED DRAWINGS] Fig. 1